1922.

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA.



# PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

# REPORT

TOGETHER WITH

## MINUTES OF EVIDENCE

ON THE QUESTION OF THE

# PROPOSED CONSTRUCTION OF A MAIN INTERCEPTING SEWER FROM THE CENTRE OF THE CITY OF CANBERRA TO CONNECT WITH THE MAIN OUTFALL SEWER.

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MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

*(Third Committee.)*

The Honorable HENRY GREGORY, M.P., Chairman.

| *Senate.* | *House of Representatives.* |
|---|---|
| Senator Hattil Spencer Foll.* | Llewelyn Atkinson, Esquire, M.P.‖ |
| Senator George Henderson.† | The Honorable Frederick William Bamford, M.P.* |
| Senator John Newland, Vice-Chairman.‡ | David Sydney Jackson, Esquire, M.P.¶ |
| Senator Edward Needham.§ | George Hugh Mackay, Esquire, M.P. |
| Senator William Plain.* | James Mathews, Esquire, M.P. |
| | Parker John Moloney, Esquire, M.P. |

* Appointed 28th July, 1920.
† Resigned 22th July, 1920. Re-appointed 30th June, 1920.
‡ Re-appointed 28th July, 1920.
§ Ceased to be a Member of the Senate
‖ Resigned 12th May, 1921.
¶ Appointed 19th May, 1921.

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LIST OF WITNESSES.



EXTRACT FROM VOTES AND PROCEEDINGS OF THE HOUSE OF REPRESENTATIVES.
No. 204 OF 6TH DECEMBER, 1921.

13. PUBLIC WORKS COMMITTEE—REFERENCE OF WORK—FEDERAL CAPITAL CITY—SEWERAGE.—Mr. Groom moved, pursuant to notice, That, in accordance with the provisions of the Commonwealth *Public Works Committee Act* 1913-1914, the following work be referred to the Parliamentary Standing Committee on Public Works for its investigation and report thereon, viz. :—Sewerage, Federal Capital—Construction of Main Intercepting Sewer from Centre of City to connect with main outfall sewer.

Mr. Groom having laid on the Table plans, &c., in connexion with the proposed work—

Question—put and passed.

# MAIN INTERCEPTING SEWER FROM CENTRE OF THE CITY OF CANBERRA TO CONNECT WITH MAIN OUTFALL SEWER.

# REPORT.

The Parliamentary Standing Committee on Public Works, to which the House of Representatives referred for investigation and report the question of the construction of a main intercepting sewer from the centre of the City of Canberra to connect with the main outfall sewer, has the honour to report as follows :—

## INTRODUCTORY.

1. In March, 1915, the Parliamentary Standing Committee on Public Works submitted to Parliament a report on a proposal to construct a main outfall sewer from the western boundary of the city to Western Creek, a distance of approximately 3 miles. After exhaustive investigation of the project, involving also the question of the treatment of the sewage and the disposal of the effluent at Western Creek, the Committee recommended that the work be proceeded with.

## PRESENT PROPOSAL.

2. It is now proposed to proceed with the next stage, namely, to construct a main intercepting sewer on the south side of the Molonglo River from the western boundary of the city to a point approximately in the centre and directly opposite the proposed Parliamentary group of buildings, a distance of a little over 2 miles. From this point in the future will extend two main sewers—one on the northern side of the river ultimately extending to Duntroon Military College, also taking in on its way sewage from Acton and the proposed civic centre, and one on the southern side extending to the Power-house and Eastlake sections.

It is intended that the section of the sewer now proposed shall be a continuation of that previously reported upon and approved by the Committee, namely, oviform in shape, of a size 5 ft. 6 in. by 3 ft. 8 in., and constructed of concrete.

## ESTIMATED COST.

3. The estimated cost of the section now under consideration is £66,000, and the time set down for completion eighteen months from the date of commencement.

## REASONS FOR THE PROPOSAL.

4. It was explained to the Committee in evidence that the reason why this proposal is brought forward at the present time is that it is desired that this sewerage work be pushed forward so that it may be completed by the time that Parliament may be expected to meet at Canberra. By that time it is anticipated there will be a considerable population to be provided for, and instead of having makeshift arrangements in the shape of earth closets or numerous septic tanks, the sewage from the Governmental block should be delivered into the sewerage system. It is held that this can only be done by making a start with the section now proposed during the present year.

## COMMITTEE'S INVESTIGATIONS.

5. After taking evidence in Melbourne, a Sectional Committee was constituted, and four members left for Canberra on the 16th December, 1921, where the proposed line of the sewer was traversed as nearly as possible, and further evidence was taken from the Director-General of Works, and the Chief Engineer, Department of Works and Railways. Subsequently the Sectional Committee proceeded to Sydney and obtained evidence from Messrs. de Burgh, Sulman, and Ross, members of the Federal Capital Advisory Committee.

6. *Size of Sewers.*—In the course of evidence, it was stated that this main intercepting sewer has been designed of a size 5 ft. 6 in. by 3 ft. 8 in., so as to be capable of taking the sewage of a population of from 100,000 to 125,000 people.

7. From the terminal points of the section now proposed junctions will later be effected with other main sewers from the city—one taking the flow from the northern area and the other the flow from the southern area. The approximate size of these sectional mains will probably be 3 ft. 6 in. by 2 ft. 4 in., and the reticulation leading off from them will be still further reduced in size.

8. *Gradient.*—The gradient of the outfall section and the section now under consideration will be 3 feet to the mile. The gradient of the branch sewers has not yet been determined, but will probably be a little steeper.

9. The distance from the outfall at Western Creek to the most distant locality of the city to be sewered will be about 8 miles.

10. *Completed Cost.*—As the fact that the sewering of Canberra is being undertaken in sections may lead to some misconception as to the estimated cost, it may be well to give some idea of the total cost of providing the sewerage facilities for the City of Canberra, as projected in the Report of the Federal Capital Advisory Committee—

| | £. |
|---|---|
| (*a*) On the main outfall, from the city boundary to Western Creek, the sum of .. .. .. .. .. .. .. | 36,000 |
| has already been expended, and it is estimated that a further sum of .. .. .. .. .. .. .. | 50,000 |
| will be necessary to complete it. | |
| (*b*) The section now under consideration, which will terminate near the site of the proposed hostel, is set down at .. .. .. .. | 66,000 |
| (*c*) The southern main sewer section, which will serve the area set apart for Parliamentary and Administrative buildings, is estimated to cost .. .. .. .. .. .. .. | 25,000 |
| (*d*) The southern main sewer section, running from Federal-avenue to the vicinity of the Power-house, is estimated to cost .. .. | 20,000 |
| (*e*) The south main sewer, Eastlake section, is set down at .. .. | 22,500 |
| (*f*) The northern main sewer, crossing the Molonglo River, skirting the north side of the Ornamental Lakes and taking in sewage from the civic centre and Acton, is estimated at .. .. .. | 55,000 |
| (*g*) And the northern main sewer extension, taking in Duntroon Military College, is set down at .. .. .. .. .. | 40,000 |

This makes a total, excluding treatment works, sub-mains, and reticulations of £314,500.

11. *Treatment Works.*—The Committee was informed in evidence that the cost of the treatment works to be established at Western Creek had been roughly estimated at £3 per head of the population to be served, or a total of £54,000 for the 18,000 people estimated to be resident in Canberra at the end of six years from the date of the commencement of continuous work. This cost per head will decrease as the population increases, but to what extent it is difficult to estimate. However, the estimates in this regard can, at the present time, be taken only as approximate, as no finality has yet been reached as to the actual system of treatment to be adopted.

12. In submitting to Parliament in 1915 its report on the Outfall Sewer at Canberra, the Committee stated :—

> "Although in the course of its investigations the Committee gathered some valuable information as to the various styles of septic tank and systems of treatment of sewage, it realizes the rapid strides being made in sanitary science and refrains from suggesting the adoption of any particular system, in view of the fact that what is considered the most up-to-date system at the present time may be superseded by a more efficient system by the time it will be necessary to erect treatment tanks at Western Creek.
>
> The Committee, however, strongly recommends that immediately prior to the date on which it is proposed to erect treatment tanks, exhaustive inquiries be made with a view to the installation of the most up-to-date system then obtainable."



13. Although considerable improvement in the treatment of sewage has taken place since that Report was presented, the information placed before the Committee leads it to the opinion that even the most improved methods of to-day are still largely on their trial.

14. Under these circumstances, it is recommended that, when the time is approaching when it will become necessary to instal treatment works, that particular question be the subject of a further reference to the Committee, so that the most efficient system then available may be adopted.

15. *Reason for High Cost.*—The cost of installing the sewerage system at Canberra might have been considerably reduced if early settlement had been restricted to the south of the Molonglo ; but the general concensus of opinion is that, to preserve the integrity of the premiated design, it is necessary to develop the areas north and south of the Molonglo River simultaneously. With this opinion, the majority of the Committee concur, but the result is that it involves the construction of long lengths of sewer main for the purpose of conveying the sewage from widely separated centres.

In the early stage of development, it is probable that, on account of the small amount of sewage to be carried, the mains will be need to be flushed periodically, but the Committee was assured that this would have no deleterious effect on the treatment at Western Creek.

16. *Local Treatment.*—Consideration was given to the question as to whether, for some time at least, the sewage from the City of Canberra might not be dealt with by local treatment tanks, but in view of the determination of the Government to proceed continuously with the work of establishment of the Federal City, the Committee is of opinion that if the anticipated development of Canberra, as outlined in the Advisory Committee's Report is realized, local treatment tanks would be neither satisfactory nor desirable.

17. *Construction.*—It was ascertained in evidence that practically the whole of the construction will be done by tunnelling. Any considerable amount of open trenching is said to be improbable, because of the depths at which the mains have to be laid. This depth is determined by the gradient and the points to which the sewage has to be taken.

Careful consideration was given to three alternative systems of constructing the sewer. One was to continue what had already been commenced—a massed concrete sewer built *in situ*. Another was to have a brick lining with a concrete invert, and a third alternative was to use reinforced concrete pipes.

It was stated, however, that the cost of bricks made it impossible for a brick sewer to be constructed as cheaply as in concrete, because for the concrete suitable stone and sand is at hand locally, and, again, with bricks there is always a difficulty of having two trades, that is to say, bricklayers and their labourers, working in the same drives as concrete workers.

Pre-cast massed concrete pipes would have to be of such a thickness and weight as to make it extremely difficult to get them into the tunnels, and re-inforced concrete pipes offer much the same difficulty, in addition to being very costly.

It was stated in evidence that the estimated cost of the mains under the various methods considered would be—

Massed concrete *in situ*, £2 17s. per foot run of tunnel ;
Re-inforced concrete pipes, £4 3s. 6d. per foot run of tunnel ; and
Brick, £3 16s. 6d. per foot run of tunnel.

Under these circumstances, the Committee agrees with the departmental proposal that the main sewers shall be constructed of concrete built *in situ*.

18. *Financial Aspect.*—The Committee finds some difficulty in reviewing the financial aspect of this project by reason of the fact that the expenditure on sewerage at Canberra will be disproportionately large per head of population in the early stages, because mains are being provided suitable for a sewerage system of a city of 125,000 people when the population of Canberra is unlikely to reach half that figure for many years.

In taking this action, the Committee considers that commendable foresight has been shown, but nevertheless it is obviously inequitable that the early residents should be rated at a figure commensurate with the cost of the full service.

Owing to the unique position Canberra occupies in that water supply, storm-water drainage, sewerage, &c., are being established to meet the ultimate need of the city, when the service required in the first decade may be a fractional part of the completed project, it is certain that, for many years, these city services will be run at a loss.

Possibly some method will have to be devised whereby a-rate is struck under which ratepayers will be liable for the same amount as they would have to pay if the full number of people, which the system is capable of serving, were in residence—the Commonwealth itself being responsible for the difference between the amount collected and the actual amount required.

This might be met by the establishment of a fund something in the nature of a city service fund, which might be debited with the expenditure above referred to and credited with the proportion of the increase in the value of city lands, which should be brought about by the existence of these services.

## RECOMMENDATION.

19. Taking all the facts of the case into consideration, the Committee agreed to recommend that the departmental proposal for the construction of a main intercepting sewer from the centre of the city to connect with the main outfall sewer be adopted.

H. GREGORY,
Chairman.

Office of the Parliamentary Standing Committee on Public Works,
Parliament House, Melbourne, 6th April, 1922.

# MINUTES OF EVIDENCE.

*(Taken at Melbourne.)*

WEDNESDAY, 14TH DECEMBER, 1921.

*Present:*

Mr. GREGORY, Chairman;

| | |
|---|---|
| Senator Plain, | Mr. Mathews, |
| Mr. Bamford, | Mr. Parker Moloney. |

Percy Thomas Owen, Director-General of Works, Department of Works and Railways, sworn and examined.

1. *To the Chairman.*—The sewerage work at Canberra, proposed to be undertaken during the forthcoming twelve months, is the completion of the outfall sewer which has already been approved by the Public Works Committee and sanctioned by Parliament. The fundamental basis of the scheme is the removal of sewage by water carriage to the outskirts of the town in contra-distinction to any system which would treat it within the limits of the town. The outfall sewer is proposed to be completed to Western Creek, where there are areas considered suitable for the treatment of the effluent from the sewerage in contra-distinction to the treatment of crude sewage. The length of sewer approved by Parliament from point A to the outfall at Western Creek is, roughly, 3 miles. This portion of the work was partly completed several years ago. A great deal of the tunnelling has been driven and a considerable section has been lined. The treatment of the sewage at Western Creek will be biological, followed by spreading the effluent over the surface of the ground, with two objects in view; one, to most fully complete the purification; and the other, to avoid any possibility of the sewage effluent being discharged into the Molonglo River in any objectionable condition. The Department, when the matter was submitted to the Public Works Committee and approval was given to the works, continued the construction of the outfall sewer until a Royal Commission was appointed, and the Royal Commissioner reported that he considered the scheme for having an outfall sewer should be replaced by a method of treating the sewage within the city area. I need not deal with that matter. The Committee has seen the report of the Commission and the report of Mr. de Burgh, a member of the Advisory Committee, who was asked to look into the matter and submit a report. His report is attached to the first general report of the Advisory Committee. The opinion of the Royal Commissioner was that an intolerable nuisance would arise if crude sewage were dealt with at Western Creek; but the Public Works Committee is concerned only with the Department's original proposal for the treatment of effluent and not crude sewage. I was not able to make the Royal Commissioner realize that. I had never proposed the distribution over the land of anything but effluent, and the report given against the system of sewerage suggested by the Department was based upon a false assumption that the treatment of crude sewage had been intended, whereas the approval of the Public Works Committee has been based upon the distribution of the effluent only. The crude sewage is first dealt with biologically, and it was only the subsequent effluent that is distributed over the surface of the ground. However, all that has been settled now. The Government have adopted the recommendation of the Public Works Committee, and the main outfall sewer is to be proceeded with, together with the construction of a section from point A to point B, which is the corollary of the construction of the section from point A to the outfall. This section is to be an oviform sewer, with internal dimensions of 5 ft. 6 in. by 3 ft. 8 in. It is also proposed to construct this form of sewer from point A to point B running towards the city. The work proposed to be done during the coming twelve months will consist principally of the completion of the section from point A to the outfall. This work has already been approved by Parliament. The work of building from point A to point B could not be taken in hand without reference to the Public Works Committee. Although the main expenditure will be incurred on the section from point A to the outfall, money must also be spent on the A-B section, which is the work the Public Works Committee has been asked to report upon. We are in a difficulty owing to the fact that all work upon the sewer was stopped by the Government, and the Department has never known whether that decision would be reversed. When work was stopped all ladders were removed from the shafts and all plant was removed. Expenditure will be involved in replacing these ladders and in inspecting the condition of the drive and shafts. We expect that a good deal of the tunnelling will be in a very fair condition, because it was driven through hard blue rock, but as some of the ground passed through is softer decomposed rock, a portion of the work may have fallen in. Possibly some of the shafts may have fallen in. However, the damage cannot be disclosed until an investigation is made. When it was announced that work was to be resumed upon this sewer, I secured approval for an expenditure of a sum of money to enable this investigation to be undertaken. The outfall sewer was designed to be large enough to take the sewage of a population of about 100,000. My evidence before the Public Works Committee, years ago, was that it was designed to take the sewage of 125,000 people. Mr. de Burgh estimates the number at 100,000. It is proposed that the sewer from point A to point B will be the same size as the sewer from point A to the outfall, namely, 5 ft. 6 in. by 3 ft. 8 in., but the size of the branch sewers running from point B to the south-east of the future city, and from point B to the north of the proposed city will be 3 ft. 6 in. by 2 ft. 4 in. The gradient of the outfall section and from point A to point B will be 3 feet to the mile. The gradient of the branch sewers from point B to the south and to the north is still under consideration. It is possible that it will be a little steeper than the gradient from point B to the outfall. The estimated cost of constructing the sewer from point A to point B is £6 per lineal foot, which includes all accessories, for instance, the cost of shafts and manholes. We cannot estimate what sum will be required to make good any excessive damage or deterioration if

such has occurred in the portion of the sewer already constructed between point A and the outfall, but the Chief Engineer (Mr Hill) thinks that the estimate of £6 per lineal foot should reasonably include it. In accessories, I include replacements and the wiring up of the motors for the compressors. These compressors are still in stock, but certain replacements will be necessary. What damage has been done in the shafting and tunnelling will be ascertained within a few weeks after resuming work. As the crow flies, the proposed hostel will be about 4½ miles from the site of the effluent treatment. The Melbourne system deals with crude sewage, whereas, at Canberra, the proposed treatment will be biological—that is, septic—after which, the effluent will be filtered and pumped over the surface of ground. Normally, there should be no nuisance from the effluent. It will have very small manurial effect, not any more than water has. The distance from point A to point B is 11,000 feet, so that the cost of the proposed sewer between those points, at the estimate of £6 per lineal foot, will be £66,000. Already £35,000 has been spent on the sewer between point A and the outfall. The heavy expenditure is probably due to the large area which the city is proposed to cover.

2. *To Senator Plain.*—A great portion of the tunnel already completed between point A and the outfall is driven and lined. The concrete is built *in situ*. We have already driven for 1¼ miles, and more than half of that distance has been lined. In addition, shafts have been sunk to carry on further tunnelling, so that a fair proportion of the work had already been completed, at a cost of £35,000, when work was stopped. I do not anticipate that much damage has been done to the unlined portion, because the tunnelling was through hard rock. I anticipate difficulty in regard to that portion which passed through decomposed rock.

3. *To the Chairman.*—I have brought with me a general plan of the proposed sewer, based on a contour plan which is fairly accurate, but the final longitudinal section must be based on a detailed survey which has not yet been completed. I think the Committee can get all the information it desires from the lay-out on the contour plan. It will be accurate to within a few feet in regard to location, and also in regard to depths. Until the street surveys are carried out by the Surveyor-General, it is not feasible to lay out the exact location of the sewer and its manholes. Full details cannot be ascertained until we have sunk shafts, following on computations of the survey of the surface. These shafts will disclose exactly the nature of the geological formations through which the sewer will be run, but from surface indications and the banks of the Molonglo, we have sufficient to guide us in making an estimate of £6 per foot. I have brought a plan showing to a larger scale the section A to B, and showing the relationship of the proposed sewer and the manholes to the lay-out of the adopted plan of the city, with such deviations as are necessary or anticipated from an engineering point of view. In addition, I have brought a section of the sewer, the surface levels being adopted from the contour plan. It discloses the depths of the manholes. I have also brought a plan showing the typical manholes and vent pipes. I may mention, at this stage, the reason for bringing before the Committee a proposal to construct the sewer from point A to point B. Under the scheme of the Advisory Committee this particular sewerage work must be pushed forward against that time when Parliament may be expected to meet at Canberra. By that time, of course, there would be a considerable population to be provided for, and, instead of having makeshift arrangements, in the shape of earth closets or numerous septic tanks, the sewage for Parliament House could be delivered into the sewerage system. This could only be done by making a start with section A—B during the forthcoming twelve months. It has been suggested to me by some people who have been accustomed to reside in places where the earth system has been in vogue, that we could establish such a system at Canberra in the meantime, but I do not think that Parliament, when it came to sit at Canberra, would thank the Advisory Committee or the Works Department for the establishment of an offensive and expensive earth system, or temporary arrangements for earth closets, when a sewerage system was to be brought into existence within a year or two. Therefore, the Advisory Committee recommends pushing on with section A—B. The proportion of expenditure upon the section from point A to the outfall and upon section A—B will depend upon how we can get at the former section. At the present time I cannot give a definite statement as to how much money will be spent on each.

4. *To Mr. Bamford.*—We have given consideration to the Kaustine system. The cost per unit is considerable, and I do not think that it would be a good system to instal. I do not know of any other method by which the matter is rendered absolutely odorless and innocuous without water. It is a most excellent system in certain circumstances.

5. *To the Chairman.*—Even if we push on with section A—B the Advisory Committee considers that the proposed hostel would need some temporary treatment, pending the completion of the sewer, because we could not get the work sufficiently advanced if the building be proceeded with at once. But the establishment of temporary treatment works for the hostel would not be as difficult or as expensive as would be the works necessary for treating an area such as the governmental group. A small but effective plant for the hostel could be so located that when the main sewer ultimately passed it the sewage could be discharged into it. The lay-out of the main sewers from point B northward and to the south-east accords with the general principles of development suggested by the Advisory Committee, and although the Public Works Committee is not considering them now, it may be of interest to know that the area for the civic centre can discharge its sewage into the northern branch sewer. In the meantime, for the development that takes place, it may be necessary to instal a temporary expedient. When the work of sewering the whole area was first taken into consideration the Department considered that it had to provide means for permitting people to live in the area, and, therefore, it was necessary, as with the water works, to make an early start with sewers, so that the work would be well in hand before settlement came about. Of course, partly as the outcome of the war, the Government could not proceed with the work, and, in consequence, we are now pushed for time. For that reason, I recommended to the Minister that, instead of devoting our operations entirely to the outfall section, we should also proceed with the intermediate section; and do as much as we could in the present year.

6. *To Mr. Mathews.*—It is suggested that the first development of settlement should be to the north-east of the civic centre, in the location Mr. Griffin calls No. 1 Neighbourhood, and which he also proposed to develop. The development suggested by the Advisory Committee in its report, to the south of the Molonglo would lie to the south-east of Kurrajong, the site of the Capitol.

7. *To the Chairman.*—There are three sites for proposed railway stations. The first is at East Lake, less than a mile to the south-east of the power-house. The second is the proposed central station on the north of the Molonglo, and about half a mile to the west of the Military College. The third is the civic centre station to the north of the hill known as Vernon, and about half a mile from the Molonglo. The Advisory Committee proposed a temporary railway station on the north side. A permanent station cannot be provided,



because the line at present is on a temporary grade, ultimately it will be a sunken line. For construction purposes, the railway will prove of great value. Attention will be given in the early stages to the collection of sewage on the north side. I first estimated that the scheme would cope with the sewage of a population of 125,000, and I am still satisfied that it will do so, but it might be better to estimate that it will cope with a population of between 100,000 and 125,000. Of the work already completed, nearly all the shafts are sunk, and half of the tunnel driven has been lined. The Department had under very close consideration three alternative systems of building the sewer. One was to continue what had already been commenced—an entirely concrete sewer. Another was to have a concrete invert and a brick sewer in two rings. A third alternative was to use reinforced concrete pipes. We came to the conclusion that for this size of sewer lining with concrete *in situ* was the best method to adopt, and the estimate I have submitted is for a concrete sewer. I have not absolutely finalized the matter. I had hoped to be able to use bricks, but, on the costs of construction submitted to me, at the present time, a brick sewer would cost more. The price of stiff plastic bricks is £3 18s. per thousand. We could make a dry-pressed brick at a less cost. We have in hand a good many arch bricks which cost less, because labour was not so costly at the time they were made, but I would not like to say that hard, dry-pressed bricks would be the best to use. We adopted soft plastic bricks, because we were at times informations in which we came across indications of lime, and this kind of brick eliminates any ill effects from that source. It would certainly bring down the cost of bricks if we adopted dry-pressed. The price of bricks in Melbourne is over £3 per thousand at the kilns, but the brick produced at Canberra is superior. To some extent, that is due to the fact that we have the shale right alongside, but it is mainly because we have installed a plant capable of turning out a very high quality of brick. The grinding is much more costly as we carry it out. Coal fuel is very costly. Wages are considerably higher at Canberra. Thus, we have extra expense to contend with as compared with Sydney brickmakers. If the manager of the brick works could get his bricks away as soon as he could make them, it would not decrease the cost of producing them, but would simply reduce handling charges. As soon as we can get definite areas laid out for cottage construction, bricks will be delivered straight from the kilns to those areas. I was very anxious to use bricks for the sewers, because I could get direct delivery from the kilns, and then, when this work was completed, we could get direct delivery from the kilns to the hostel or the schools or colleges, but it is questionable whether bricks, even at the lowest price at which they can be produced, could compete with concrete in the sewer, because for the concrete we have the aggregate and sand at very low cost, whereas, with bricks, there is always the difficulty of having two trades working in the drives, that is to say, bricklayers and their labourers working in the same drives as concrete workers. In any case the manholes must be put down in concrete. The pre-war cost of building these sewers was £5 per lineal foot. We estimate that the work will now cost £6 per lineal foot. The estimated cost of the sewer from point A to point B is £66,000. This section follows the road formation as far as possible. I cannot give an estimate of what will be the likely cost of completing the section from point A to the outfall until the damage has been investigated, but we are providing £50,000 to complete the section, on which £33,000 has already been spent. This is exclusive of the cost of the treatment plant. The original estimated cost of the treatment plant was £22,500. We were then working on the basis of a population of 25,000, but the outfall works, tanks, and pumps, for 6,000 people would cost £18,000. We now estimate that a further £36,000 will be required for outfall works, tanks, and pumps for a total population of 18,000. With a greater population, the effluent has to be carried further for distribution. Under Mr. Oliver's scheme, the effluent from the septic tank was to be distributed into the Molonglo. If we are to say treatment works were established for 10,000 they are likely to cost a considerable sum of money. For £28,000 we can biologically treat the sewage for 6,000 people. I contended, in regard to the proposed treatment at the Yarrabinda Creek, that the cost would be greater than could be the interest payable on the extra expenditure upon the additional length of outfall sewer required for putting the treatment works in a suitable location. I would need to go into details, which I have not with me now to how why it will cost £30,000 more to provide for an extra 12,000 people. In the early stages it will be necessary to extend the branch sewer southward from point B to point D at the following cost, point B to point C, £25,000, point C to point D, £20,000. It will also be necessary to extend from point D north to point F (Prospect Park), at a cost of £55,000. Each of these branch sewers will be 3 ft. 6 in. The work upon section point A to B will be more expensive, because of the larger size and greater length of the sewer. Eventually, the sewer will run to the Military College and East Lake. The levels will permit of its being done, but we are not catering for that work in the earlier stages. Approximately, the total cost of the main sewer and treatment plant for 20,000 people will be £270,000. In regard to Mr Oliver's scheme, my opinion is that no community would put up with treatment works within its area, that is, on a permanent basis. The sedimentation process recommended by him would entail the removal of a lot of sludge in a semi-fluid or dry state, and in either stage the process would be extremely objectionable. The sludge would have very little utility as a manure. I can quote the opinion of Mr Karl Imhoff, which I did not have when the Royal Commission was taking evidence on this point. It is an extract from the Metropolitan Sewerage Commission of New York, dated the 30th April, 1915:—

> Karl Imhoff considers that the Emscher tanks would probably hold back one half of the sludge, and that which would be retained would be more objectionable than that which escaped. Their efficiency might be augmented by the use of chemicals, this would require that the sludge chambers be increased.
>
> In the outlying districts of the city, Emscher tanks could, in Dr. Imhoff's opinion, be advantageously combined with percolating filters. In the city limits, filters of this type would not be admissible, because of the larger areas required and the nuisance from odour and flies which would be practically certain to arise from them.

It was the "Emscher" which Mr Oliver proposed for Canberra, and which I opposed all I could. Perth is the only big centre in Australia where sewage is biologically treated within the city area, and there has been quite a agitation there to get the State Government to abate the nuisance created by the tanks. Septic tanks can be established anywhere. They will have no deleterious effect from the carriage of sewage for the distance we propose, and I am sure that no community would allow treatment of sewage within the area of settlement if there was any possibility of having it done outside. For the proper biological treatment of sewage, no longer period than is feasible should elapse after cessation. We have secured expert evidence on the point and it was universally considered that the length of time which would elapse before sewage could be treated under our system would not be deleterious. Of course theoretically it should be treated as soon as possible, but there is no objection so long as the length of time is reasonable, and the length of time involved at Can-

berra would not be excessive. From the furthest point of intake to the outfall—that is, 9 miles—it should not be from five to six hours.

8 *To Mr. Bamford.*—If a concrete pipe is to be introduced into the tunnel instead of building *in situ*, it must be reinforced, and then the concrete would not require to be more than 3 inches or 4 inches thick. We have been building *in situ*. It seems to us to be the cheapest form of working. A 3-in. thick concrete pipe, without reinforcement, would not hold together. A pipe, not reinforced, would require to be from 9 inches to 10 inches thick, which would be too heavy a load to handle, to get it down the shaft and into position. The oviform sewer has been adopted to get the invert into a small radius, which improves the velocity of the flow of the sewage. A big radius does not give a small wet perimeter. A lot of the section already driven has been timbered.

9. *To Mr. Mathews.*—In the earlier stages we will have difficulty of flow. With a population of only 5,000 or 6,000 I think it will be necessary to flush the sewer occasionally from the Molonglo, and pay some attention to it; but as the population grows, we shall, in all probability, have a discharge of 50 gallons per head into the sewer. We have allowed for a velocity of 2.3 feet per second, which, I think, is quite reasonable. I would not permit storm water to go into the biological treatment plant, but, in the earlier stages, we might use it for scouring purposes. We must flush occasionally when the population is low. Mr. de Burgh was exercised on the same point, and came to the conclusion that it would be the proper thing to do to overcome the difficulty occasioned by a small discharge in the earlier stages of development.

10 *To Mr. Parker Moloney.*—The Melbourne sewers are concrete. The Geelong sewers are reinforced concrete pipes, and these have been extensively adopted by Mr. de Burgh in New South Wales. I have had a discussion with him, and I was going to get further information from the Monier works in Sydney. We determined that it was cheaper to build in concrete *in situ*. The governing factor was that we had the aggregate and the sand, and that the use of brickwork was cut out by the increased cost of wages. I do not think the price of labour will be reduced until we have enough people there to make Canberra a centre. The estimate of £6 per lineal foot is based on the work already done, taking into consideration the increased cost of cement and labour. We have already constructed about three-quarters of a mile of concrete sewer.

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*(Taken at Melbourne.)*

THURSDAY, 15TH DECEMBER, 1921.

*Present:*

Mr. GREGORY, Chairman.

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|---|---|
| Senator Plain, | Mr. Mathews, |
| Mr. Bamford, | Mr. Parker Moloney. |

Percy Thomas Owen, Director-General of Works, Department of Works and Railways, recalled and further examined.

11. *To the Chairman.*—The estimates of the cost of the main sewers as proposed in the departmental scheme and set out in detail on page 31, appendix D, of the first general report of the Advisory Committee may be accepted as correct. The estimated cost of the treatment plant for a population of 6,000 is £18,000, and for a population of 12,000, £36,000. It is approximately £3 per head, but that figure is indefinite, because the form of treatment has not yet been decided upon, and I again advise the Committee that it should not decide earlier than is necessary to commence the work of installation. The activated sludge treatment in New South Wales has, I gather, from Mr. De Burgh, shown some disabilities. It may be that we shall recommend for Canberra the simple biological treatment, but whatever the treatment is, £3 per head is set down as a reasonable figure to cover it. The area which the main sewers will serve is very large, because branch sewers will radiate from them and will cover practically the whole of the city plan. The district reticulation sewers for a population of 6,000 people are estimated to cost £38,400, and for a population of 18,000, an additional £76,000. In regard to the population that will be at Canberra on its initial occupation, I consulted the secretarial heads of Departments, and the results of my inquiries are embodied in a schedule to the Advisory Committee's report (page 35). Those forecasts are open to modification from month to month. For instance, it is possible that some Departments may be much reduced within a year or two. But that schedule represents the anticipations of the heads of Departments at the date at which the report was framed. The gross costs of the sewerage scheme are shown in appendix "H" of the Advisory Committee's report.

12. *To Mr. Mathews.*—Estimates as to the staffs that will be at Canberra during the course of construction and afterwards are also contained in the appendices to the report. We ascertained, as closely as possible, the total population dependent on the members of Parliament and the administration, which would be collected at Canberra in the first stages. The first stage, broadly speaking, will be that in which all the sections of administration, except defence—military, naval, and air force—have been transferred to Canberra. I consulted the secretarial heads of those Departments, and also General White and the Navy Board, and they were agreed that the Defence Departments must be transferred as one unit, or not at all. When Parliament first assembles at Canberra, the Defence Departments could be represented by secretariats, and the central administrative staff would move to Canberra in the second stage. The town of Queanbeyan is not covered, and that fact has received consideration by the Department. It would be possible to gravitate from Queanbeyan, but from our point of view, that would not be advisable. The existing conditions could not be allowed to continue alongside a properly sewered Federal Capital, but the sewering of Queanbeyan is a matter to be undertaken by the State Government, because, although the Commonwealth has water rights over that area, it is not part of the Federal Territory. If the proposal to establish an arsenal at Tuggeranong is proceeded with, that centre will have a separate scheme of water distribution and sewerage. Tuggeranong could be linked up with Western Creek, but the distance is too great and the cost would be excessive. The sewers at Canberra will follow the roadways, as far as possible, without incurring undue expense, and increasing the engineering difficulties of construction. It is assumed that in the course of years the whole of the area through which the sewers run will be populated. Unless we lay an inverted sewer syphon, which would not be good practice, the concrete channel will cross the bed of the Molonglo, and will be exposed for portions of the way. If we do not use an invert, the crest of the sewer will be above the present level of the Molonglo. One method would be to discharge over the top of the sewer, and the other way would be to put in water gates and allow the water to go clear. We might make a dam of it and back up the Molonglo, but that would raise the level of the river 4 feet or 5 feet at the temporary bridge, and I would not like to do anything to jeopardize the existence of that structure. It is necessary in order to maintain access from the northern to the southern side of the city area. With normal floods, the bridge would not be jeopardized, but if an abnormal flood happened the result would be serious. The project is to carry the sewer along without an



inverted syphon, but I have not yet finally decided whether to back the water up or to install water gates, so that the water may go clear. That question will probably be discussed by the Advisory Committee at its next meeting. Difficulties would be created if we attempted to connect from D back to the western portion of the city. We must have a gradient of 3 feet to the mile, and a connexion to D would involve a tremendous length of sewer. The development about the civic centre is likely to be closer to B and to D. We regard the crossing shown on the plan before the Committee as favorable, and it gives us rock for our foundations.

13. *To Mr. Parker Moloney.*—The treatment plant, if the biological system be adopted, will be at the end of the outfall sewer at Western Creek. After the sewage has been treated in the anerobic tank the effluent will be lifted and distributed by pipes over the ground, in order to avoid any direct discharge into the Molonglo River. The treatment tanks will be about half a mile from the river, and that will be quite sufficient if the effluent is to be distributed over the ground, because, after leaving the anerobic tank, it will be pumped another half a mile before being distributed. The process of laying the main sewers will depend upon the number of shafts we sink. We calculate to finish the whole work in three and a half years. That means attacking the outfall sewer and the section A to B in the first year. Unless we do that we shall not complete the work in three and a half years. The daily progress may be 5 inches or 6 inches or several feet, according to the nature of the ground in which we are driving. I should say that the actual driving and finishing will not average more than 2 feet per day. Deviations in the routes shown on the plan are due to a desire to avoid depth of shafts, to keep away from the river, and to follow the roads as much as possible. We might have obtained a more direct route by carrying the sewer along West Lake way, but that would mean deeper shafts, which must increase the cost. The whole of the work will be done by tunnelling. Open construction is impossible, because of the depths to which we have to lay the mains. The depth is determined by the gradients and the points to which we have to take the sewerage. For instance, the depth of D dominates the gradient from A to D. The main sewer will be laid at a considerable depth, but the district will be only 8 feet to 10 feet below the surface.

14. *To Senator Plain.*—Up to the present time we have had no great difficulty in getting labour. When we were doing sewerage work at Canberra previously, some men did give us difficulty, but, on the whole, I think we had a very fair lot of workers. We certainly have had a very good lot during the past few months. We shall require miners for the driving of these tunnels, and the selection of them will not be restricted to any State or district. The estimate given by the Advisory Committee is only approximate. The Committee outlined a general scheme and said at page 4 of the report—

> Upon receipt of advice that the scheme outlined in this first general report is approved, the Committee will then be in a position to advise more fully upon the other subject mentioned in the Order in Council, namely, proposal for the design and construction of the necessary works, buildings, and services.

It would have been a mistake for us to have gone into the scheme in greater detail until the general principle had been affirmed. Our investigations, so far, lead to the conviction that concrete built *in situ* will be cheaper than bricks for the mains, even if bricks are obtainable at half the present price. I think that the stiff plastic bricks would be durable enough, but if we used bricks having considerable porosity, such as the Melbourne and Sydney bricks have, and they had any considerable quantity of lime in them, we might have trouble in the course of time. We do not incline towards the use of concrete pipes because we think they would be more costly than concrete built *in situ*. Not a very great deal of concrete will be required, and it will be mixed at the spot where the men are working.

15. *To Mr. Bamford.*—Including the people at Acton, the power house, the brick works, and the farmers, the present population of Canberra must be about 500. At Acton, Duntroon, and the power house small septic tanks are installed. The cottages at Ainslie are served by a small district sewer, which will eventually run into the main sewer, and at the end of that is a small tentative system. The earth pan system is used to a small extent in the territory, and the nightsoil is buried in trenches. I think the necessary care is taken to see that sewerage is not washed out of the trenches into the river by heavy rains. After crossing the river the cuttings would be too deep to permit of the effluent from the anerobic tanks being carried in an open drain.

16. *To Mr. Mathews.*—The sewerage will gravitate from A to the outfall sewer, where it will be treated, probably in an anerobic tank. From there the comparatively pure effluent will be pumped and spread on the land.

17. *To the Chairman.*—The workmen who will be employed there may be divided into two classes. Some will be employed on the main sewer, and they will require to be suitably camped along the sewer. Later on, a large body of workmen will be employed upon buildings and engineering construction in the city area. It is proposed to accommodate them with a fair proportion of families, in the buildings that were erected for the internment of Germans during the war, and to run a small train service twice daily to and from the civic centre. In the programme put forward by the Advisory Committee I carried out there will be enough men employed to warrant the running of a tram service. The internment camp is being improved. For instance, we originally used cheap malthoid roofing, with the idea that the internees would tar and sand them. We are gradually substituting galvanized iron. The camp is equipped with water supply, sewerage, and electric light, and, although the houses are not first class villa, workmen will get some comfort out of them, and the dwellings can be made better than they are at present. We are dividing a portion of them into small flats, and doubling the partitions in order to give greater privacy. There is no proposal at present to erect workers' homes at Canberra. The men would get the camps at very low rentals, and we propose to make them quite comfortable. Some of the workmen at the power house live at Ainslie, but until a man is reasonably permanent he cannot expect to have a cottage. In regard to the method of construction, my idea is that the section from A to the outfalls should be done departmentally, and that the section A to B should be done by contract. Of course, it will be necessary to first sink shafts for the information of likely tenderers. Electric power will be available to either the Department or any contractor engaged in the construction. We have air compressors in stock, which will probably require overhauling, and if we have any over and above the number required by the Department the contractors will be allowed to use them. All the power necessary for operating the rock drills will be available. In the section A to the outfall, there can be no certainty as to the nature of the country that will be encountered. If that were thrown open to public tender we should be asking contractors to tender on an unknown basis, and they would have to submit a price that would cover them against emergencies. For that reason, we consider it better that the Department should do that work itself. In the past we have carried out engineering works very economically. We could grapple with the whole of the proposed works, but I would advise the Minister to let the section A to

B to a contractor, subject to a reasonable price being tendered, in order to have two authorities attacking the job. Of course, the Department would prepare estimates before calling for tenders, and if the contract price were a good deal higher than our estimate, I would advise the Minister to instruct us to do the work In connexion with the Stromlo and Red Hill reservoirs, the day labour cost beat the lowest tender by £9,000. We have the engineering knowledge, and we are as well able to carry out the work as is any contractor, but I would be inclined to let the A to B section to contract, in order to assist forward the Canberra scheme, by the very fact of having two constructing authorities on the job. The price of cement is still fluctuating, but we have to base our estimate on some price, and I will let the Committee know what cost we estimate for cement. We have a fair quantity in stock. I am reminded that in 1918 Mr. Hill estimated that bricks could be turned out at Canberra at 59s. per 1,000, whereas, the price for bricks from private kilns is over £4 per 1,000. I do not know at what price the Canberra works can produce the bricks to-day, but I know that current alone costs 15s per 1,000. I will let the Committee know how much per unit the brick works are being charged for current. I will also supply alternative estimates of the cost of the main sewers in reinforced concrete pipes, brick, and concrete built *in situ*. The filling required, if reinforced concrete pipes are laid in the tunnels, will vary according to the nature of the ground. At the haunches some poor concrete would be used for filling, but the filling elsewhere will depend on the extent of the cavation and the nature of the country. If the cavation is slight we might dispense with filling.

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*(Taken at Yarralumla, Canberra.)*

17TH DECEMBER, 1921.

(SECTIONAL COMMITTEE.)

*Members present:*

Mr. H. GREGORY, Chairman;

Senator Plain, Mr. Mathews, | Mr. Parker Moloney.

Thomas Hill, Chief Engineer, Department of Works and Railways, sworn and examined.

18. *To the Chairman.*—I have been making investigations and preparations with respect to the Capital City sewerage proposition as submitted to the Committee. Some work was done in the direction of carrying out the main sewer some years ago and was stopped, since then nothing further has been done. The purpose was to construct the main sewer from the city boundary to what is known as the Eleven-mile Creek, the treatment works to be established there. Since that period further reports have been provided upon the subject. Mr. C. E. Oliver, M.I.E., recommended the treatment of the sewage within the city itself, providing for eight Emscher tanks, the effluent to be eventually discharged into the city lakes. I understand that Mr. Oliver's opinion was that there would be no objection or danger from the discharge into the lakes or the Molonglo, following upon the treatment in the eight to twelve treatment tanks which he proposed should be placed at different points throughout the city. I am aware, further, that Mr. E. M. de Burgh, M.I.C.E., Chief Engineer for Water Supply and Sewerage, Department of Public Works, New South Wales, has also reported upon the project. He has had considerable experience in the construction of sewerage and treatment schemes in that State, including the Sydney systems. Mr. de Burgh is a member of the Federal Capital Advisory Committee, and has reported fully upon the scheme for this place. I have studied the various reports and methods, and I am still strongly of opinion that the carrying out of the scheme which has already been begun, and for biological treatment at the main outfall on Western Creek, is essential. I would never concur with the suggested treatment of the effluent within the city proper. It is absolutely necessary that the sewage should be taken the distance proposed outside of the city. With respect to the work upon the main intercepting sewer on the south side of the Molonglo River, as shown on plan from "A" to point marked "B" in the departmental scheme, the same method of construction is intended—I refer both to construction and to formation—as was carried out in the original work. The type of sewer is egg-shaped, 5 ft. 6 in. by 3 ft. 8 in., with concrete block invert. At the point "B" the scheme is to affect junctions with the other main sewers from the city, one taking the flow from the northern area and another taking the flow on the southern area, as shown in dotted lines marked on the plan. The northern main sewer is to go from the point "B," crossing the Molonglo, approximately as far as Duntroon College, while the southern sewer will go from the point "B" to approximately the point "E" on the plan, with provision for extensions as may be required in the future. The approximate size of these lesser mains as suggested, although not yet definitely decided upon, is 3 ft. 6 in. by 2 ft. 4 in. oviform. The distance from the outfall at Western Creek to the most distant locality of the city to be sewered is, approximately, 8 miles. Upon the point whether it will make any difference in respect of the proper biological treatment of the sewage, I would expect some change to take place in the course of the flow varying with the length of the flow; but the distance in this proposed scheme is not an extreme length for sewage to be conducted. For example, in Melbourne, from Surrey Hills to Werribee the flow takes about two and a half days; but it is not treated biologically there, as is here proposed. Upon the question whether, if the period were excessive, the biological treatment would not be successful or thoroughly effective, I can only say that there is nothing in the length of the mains here proposed which should be in any way harmful. I certainly see no objection from that point of view. I have just mentioned that from the point "B" on the plan the pipes will be of similar capacity. The two main sub-branches will be reduced in size and the reticulation leading off therefrom will be further reduced, eventually finishing with a 6-in. pipe. I am asked whether full examination has been made so that there shall not be the slightest doubt that, with the reticulating pipes into the main sewers, the whole of the city area will be capable of being dealt with. That has been fully considered, and there is no doubt whatever. There will be no question of storm waters being permitted to enter the sewers. If all storm waters were intended to enter, the size of the sewers would have to be made so large that they would be inordinately expensive and considerably more than adequate for the sewerage system. Further, it is objectionable to use the sewer system for the two purposes. In dry periods the unnecessarily large mains would be carrying a very small volume, and the result would be a lack of cleansing facilities. The inflow of large quantities of flood water would also affect the biological plant. The treatment at the other end of the system would be very seriously involved; in fact, there would have to be methods provided for deviating the flow to prevent the tanks from being flooded out. The system of laying the sewers would be by tunnelling where necessary, and, where permissible, by working on the pot-and-drive system. Shafts are sunk about every 500 feet apart. Where the lay of the country permits, the pot-and-drive will be adopted, finishing off the reticulation with open cut; but there is not much of it which will be capable of the pot-and-drive method. It will be necessary, as far as possible, to keep the line of sewerage above the 1,825-ft. level, because that will be the level of the lakes. In one or two places the sewer will pass through a level as low as 1,815 feet, but care will be taken that the water of the lakes is not contaminated before such time as the ground is made up in conformity with the design shown upon the plan. Generally, in such case as I have just mentioned, the pot-and-drive method will be used; but it will be chiefly a case of shaft and tunnel. By the pot-and-drive method I mean sinking at much shorter intervals and driving in between. It becomes a question of the cost of going down to a depth to which the sewer is to be laid, and in some cases it would be impossible to pot and drive. As regards the main sewer and the main intercepting sewers, the greater part of the work will be by tunnelling. It is proposed to form the sewerage pipes by means of concrete placed in suitable mould-boards, packed in position below. The mould-boards will be placed in the tunnel after the drive has been completed, and filling up will then be done all round to the mould-board, in concrete. That will be considerably cheaper than a reinforced concrete pipe. Inquiries have been made, and it is estimated that it will cost, to make such pipes here, about 52s. per foot run. That sum is simply the manufacturing cost. From thence the material will have to be transported to the mouth of the shafts, lowered and placed in position and laid, and then the packing will have to be placed around it. The actual cost will work out at about £4 3s. 6d. per foot run of tunnel. I estimate the cost of the ordinary concrete at about £2 17s. per foot; that includes placing in position, rendered, and packing, and every other consideration. The pre-cast concrete will cost £4 3s. 6d. The question of bricks has also been considered. I worked out the cost in that latter respect at about £3 16s. 6d. per foot run. That is with the brick lining and a concrete invert block, packed, and everything complete. The bricks for the foot run I put down at 12s. 6d. for 1¼, which works out at about 90s., delivered at the mouth of the shafts. When the Geelong sewer was tunnelled various methods were employed. The configuration of the country permitted portion of the work to be done by open cut; some was viaduct, and some was deep cutting. The sewer there was taken to the sea through pretty flat country. Much of the work was open cut, so that it is difficult to make a comparison of that system with this. My estimate for the Federal Capital system is £6 per foot run, as against £5 prior to the war. For pot-and-drive the cost would be about 10s. per foot, with tunnelling varying from 25s. to 75s. per foot, making an average cost of 50s. per foot. The country to be dealt with varies from decomposed basalt to very hard rock. Some days we would be able to do 3 feet per shift, and; at other times, only 3 to 6 inches; but an average all round, based upon previous experience, should be a cost of 50s. per foot. I recall that there was some difficulty in procuring miners for the original work at Canberra. All the operations upon that much of the work which has already been done, such as hoisting, compressing, and crushing, was carried out electrically. In my estimate, I have charged to the sewerage scheme the cost of main electrical cable, and, in fact, everything in connexion with the sewer. I think that the costs mentioned are a little low, having in mind what can be done here, and increased wages, and the distance from populated centres, and the class of men obtainable. I think that a good deal of the hard rock work is already done, and that we are approaching the shale. That is why I have not added the whole of the difference represented by pre-war and present day rates. If such were not the case, the cost would be something like £7 10s. rather than £6 per foot run. Provision for housing the workers, I take it, will be similar to that previously provided. The men will either be under canvas, or they can be fitted up in the wool-shed at Yarralumla;



but the men prefer canvas. Any other form of accommodation would not be justified, because the work would only occupy about a year. I am reminded of the decision of Parliament to carry on the work at the Federal Capital continuously, and I am asked whether better work would not be secured from a higher class of workmen, and at a more reasonable cost, if a portion of the city of Canberra were devoted to workmen's homes. I am not of that opinion. I think that if men were provided with homes in the civic part of the city proper they would be too far from their work in the first and second portions of the job. Even if that were not the consideration, it would be advisable to camp them out. I am asked whether, taking into consideration all such works as water supply, sewerage mains, road-making, and general preparations for the Capital, it is not essential that workers' homes should be provided. I say, no; not for these particular purposes. The former internment camp on the Molonglo is capable of meeting a great deal of the demand for accommodation, and the remainder would have to be met by the erection of local camps. We are not paying increased wages owing to local conditions, because we try to handle men whose conditions are such as is prescribed by Wages Boards.

19. *To Senator Plain.*—I do not know of any other city in Australia which has adopted the method of dealing with sewerage as proposed for Canberra by Mr. Oliver. I know of no place in the world, except at Emscher, in Germany, and certain cities in the United States of America. My only experience of that method of treatment has been gained by reading. The question of dealing with the storm waters has been considered. The water will be taken in separate conduits and discharged into the river. There is also a scheme for taking the storm waters from high points into other water-courses and leading them out through areas which will not be in populous vicinities to the river. I would not care to express an opinion whether the Geelong sewering scheme could have been carried out more cheaply if the same method had been adopted as is proposed here. All cases have to be considered in the light of local conditions, together with the question of the materials available; and, of course, the nature of the country itself. I understand that reinforced concrete was used at Geelong from beginning to end. Although there were open cuts, I should say that the oviform pipe of pre-cast mould would lend itself readily to that class of construction. With respect to the possibility of introducing pre-cast concrete pipes which ought to be rejected owing to a flaw, I cannot imagine a flaw in an ordinary concrete lining after it has been placed in position and rendered up. The only trouble would be, with sewers in tunnels, in regard to what is known as the packing; that is, as to whether the packing is properly made between the sewer and the roof, and that would apply to oviform construction just as in the case of concrete *in situ*. It is very difficult to get the packing between the structure and the roof. I constructed some miles of tunnel in the city of Melbourne, along Little Collins and Little Bourke streets, and I had the greatest difficulty with the bricklayers in order to insure that the packing was put into place. The packing is very liable to be scamped; the same applies to the work on the pre-cast form. After getting the pieces into position you have to pack around them, whereas with putting the concrete into place, it is done in lengths, working up from the bottom. You are sure of your work in that way, and while you have good aggregates such as are obtainable here, and with that form of construction, I do not hesitate to say that it is the best for sewers of this type. When we get further along, into the open, the pre-cast form will be considered. Advantage will be taken of the deposits of river gravel along the course of the sewer. We are not far from the river at any point,

and we can get sand also; so that we shall be able to have good aggregates handy. With such local advantages and with the method of construction such as I have described, there is certainly opportunity for doing cheaper work. As regards the completion of the main sewer, it will be best to do that by day labour. The reason is that I am afraid that a good deal of the original work, having been left untouched for a number of years, may have fallen in, and it will be difficult, therefore, to specify. As for the other section, the Director-General of Works is considering submitting to the Minister the question of obtaining tenders for it. We considered calling for tenders for the first main section some years ago, and we put down shafts for the guidance of contractors; but the prices were very high. Our idea for the future is to sink shafts at intervals before calling for tenders, so that contractors may see the type of ground to be worked. We will also provide for them to test the nature of any other part of the ground by means of further shafts. Engineering works of this character nowadays, more and more, lend themselves to departmental labour, because of the difficulty of informing contractors of the nature of the rock to be met with, which, of course, affects the cost very markedly.

20. *To Mr. Mathews.*—I realize the importance of continuity of employment, and that it is preferable wherever possible. I am asked if it is not practicable to make some arrangements for housing the workmen to cover a job of two or three years. My experience is that the men are not looking for continuous employment; they very often prefer jobs which will not take them for more than three to six months from their ordinary avocations and their home towns. Our experience at Canberra is that the conditions are such as to drive the men away. I think the climatic conditions and the lack of city environment generally detract from the men desiring to stay here. With the class of labour to be employed on the sewer I do not think that the question of housing should be considered. The question of the speed of flow through the mains, in the light of successful biological treatment at the outfall, has been closely examined. It is confidently expected that there will be no difficulty in this direction, even in the periods of smallest flows. As for the margin of safety, I should say that that would be a matter of to-day. I do not care to use the word "safety" in this respect, but I might add that the fresher the flow the more it responds to treatment. If the flow were to take three and a half days instead of two and a half, as has been suggested, I would say that both periods are too long. It is a matter of hours. In the initial stages of the population of this city some small amount of flushing may be necessary, but that is a very common requirement. Sewers have to be watched and flushing undertaken, and there is never any deleterious effect upon the treatment.

21. *To Mr. Parker Moloney.*—I am asked whether an estimate has been made of the loss occasioned owing to the abandonment of the work already undertaken. That has been taken into consideration only approximately at this stage. We have not entered into the already constructed portion of the sewer yet. I can only go into the question of replacement of plant and appliances, that would cost, perhaps, £3,000 or £4,000; but we have not yet pumped the sewer out. My estimate of £6 per running foot covered every consideration, and it was based upon the knowledge of the facts existing in respect of the previous work, which cost £5 per foot. I do not estimate that there will be a reduction in the figure, but that there will possibly be an addition. To-day there must be considerable differences in the cost of materials, and in the cost of repairs and renewals. There is also the factor of higher wages. On the other hand, we have got through some of the hardest part of the rock. With respect to the quality of the bricks manufactured here, I think that they are better than those made in Melbourne. I allowed for the cost of the bricks, delivered on the job, at £3 17s. 6d. or £3 18s. per 1,000. Taking all the factors into account, I think that the estimate is as near as can be ascertained. The type of brick manufactured at Canberra is an excellent kind for use in sewer construction, as its absorption is low. The pot-and-drive method is possible upon this work, because the men will be working under better conditions, and the amount of work to be done per foot run will be less. Once we get out of the main sewer and the main intercepting sewers, and a portion of the other smaller sewers, a great deal of the work will be pot and drive or open cut. For the main sewers it will be a case of shaft and tunnel; then, as the sewer gets smaller and nearer to the surface, the construction work will be easier. In order to carry out the work most effectively right through the job should certainly be continuous. I do not expect that the work which has been done and has been abandoned will prove to be ultimately less effective than that still to be undertaken, but it will certainly not be easy to pick up again.

22. *To the Chairman.*—I have read the report of Mr. de Burgh contained in the first general report of the Advisory Committee, and I agree with his conclusions and the estimates set out. The estimated cost, with the main sewers, is £314,500. That includes the sum of £36,000 already expended, but the total does not embrace the cost of the treatment works. The cost of the works per head of population will probably be in the neighbourhood of £8. I am asked to view the projected work from the stand-point of carrying it out for private enterprise, and I am asked whether I would endeavour to concentrate in order to obviate the expenditure necessarily incurred upon the scheme as a whole, in order to keep down the capital cost as far as possible in accordance with the population. That is, in effect, the intention. The two-year period has been decided upon with an idea of concentrating the whole of the job within that period. The total population estimated in the first five years following upon the opening of Parliament at Canberra is about 15,000. That is to say, in the first three years the number would be about 6,000, and in a subsequent period of about the same length the total would be from 15,000 to 18,000. Upon the question whether it would not be wise in the early stages to avoid the cost of the construction of the sewer main on the north side of the Molonglo, that involves a question of policy; but it appears that the Advisory Committee has kept that in view by suggesting concentration within the two-year period. I am not in a position to say whether it is necessary to build up the northern portion of the city during the early stages of parliamentary occupation. I cannot say, either, whether it would be well to anticipate anything in the nature of the establishment of civic control during the earliest stages. The basis of Mr. Griffin's plan is for the distinct development of the civic centre on the north side. If there were no such project, I should say, as an engineer, that there would be far greater opportunity for practising economy by constructing the necessary services for the south side of the river only. The construction of the cottages upon the permanent civic site will necessitate laying the sewers to that part of the capital city, with which scheme is associated the intention to lay a main to Duntroon College. If the population of Canberra increases as has been estimated, that proposal will be necessary; but if the whole of the population at Canberra were to be concentrated upon the administrative side to the south, the cost of providing the basic services on the north side could be done away with, or, at any rate, considerably postponed. According to the scheme, I anticipate that developmental work will be carried out, for the future, almost equally on the north and on the south side. To place



the whole of the population upon the south side, the road work generally will be greater. There are, within the administrative sphere, more of the 200-ft. wide avenues. This country does not lend itself so readily on the south side as upon the north to the settlement of population; that is to say, on the north of the river the land is not so undulating. It is not proposed within the present scheme of activities to complete the 200-ft. avenues. The only public works at present projected for completion on the northern side is in respect of school accommodation and the railway station. Since the design of the whole scheme of the Federal Capital is for the concurrent development of the civic and administrative centre, I am of opinion that that should be gone on with. By the time the sewer from the points A to B on the plan and to the outfall is completed, the whole of the work will be ready for use. Upon the completion of that portion of the main between the points A and B, I think that those parts between B and C and B and F should be gone on with together; that is, if the population increases in proportion to the scheme, as has already been set out. Individual septic tank treatment is being arranged for regarding the cottages in the civic area; that is to say, only for those that are built already. There will be a reticulating sewer to the main sewerage system to cope with future conditions. I would not like to see a much greater area of the city treated in this same fashion, however. It is a good provision for a development comprising about twenty houses, each housing some five people, but it should not be further extended. The costs all round make such provision for a small settlement of twenty houses expensive. It would be folly to waste money by installing small sewerage schemes if the general proposal as has been outlined before the Committee is proceeded with. In such a scheme as this we must face heavy initial costs in order to put down something that will not need to be torn up again in a year or two. I would hope to complete the main sewer from the outfall to the point "B" within eighteen months, and then the connexions could be made. Since the first work was done upon the sewer main, costs have gone up in almost every direction by at least 50 per cent.; and, in respect of certain lines, the quotations are more than double. The capacity of the local brickworks is ample. The deposit of shale adjacent to the works looks as if it would last for another 100,000,000 bricks. The present capacity of the works is 5,000,000 per annum. In estimating the shale deposits, I am merely speaking of surface conditions, without going down. Then there are other large deposits of shale close handy. Altogether, the supply should be good enough for very many years. I am asked whether, with a large plant and a big output, with no rentals and with such splendid deposits of shale, bricks should not be produced as cheaply here as in Melbourne. I would not expect that, for the reason that local wages are higher and conditions generally are different. As to whether the costs should be higher, the works are carried on strictly according to the awards and conditions laid down by the Court. There are no special conditions other than in respect of a few holidays. I might add that the original estimate in connexion with the brickworks did not include the question of amortization. The present figure includes paying for the plant completely on an output of 100,000,000 bricks.

23. *To Senator Plain.*—The biological treatment at the outfall will be of such a nature that it will not be essential to spread the effluent on the land. Provision has been made, however, at Western Creek for 3,000 acres. That area has been reserved. The soil varies in the creek bottoms from sand to gravelly clay, which has been tried for absorption and found very fair; but it is not expected to load that large area heavily. The idea is that the effluent will be spread on the land not to exceed 1 foot per annum.

*(Taken at Sydney.)*

TUESDAY, 20TH DECEMBER, 1921.

(SECTIONAL COMMITTEE.)

*Members present:*

Mr. H. GREGORY, Chairman;

Senator Plain, Mr. Parker Moloney.
Mr. Mathews,

Ernest Macartney de Burgh, Chief Engineer for Water Supply and Sewerage Department of Public Works, Sydney, New South Wales, sworn and examined.

24. *To the Chairman.*—I am a member of the Federal Capital Advisory Committee, which has furnished its first general report to the Government, together with a special report by myself upon the Federal Capital sewerage. I have carried out the large sewerage works in connexion with the city of Sydney. The greater volume of the sewage here is discharged into the ocean untreated. Some sewage is also treated inside the heads at two works, one at Folly Point and the other at Balmoral. The latter works are septic treatment works, and the Folly Point Works are, at present, almost entirely working on the activated sludge process. I have in hand, at present, the construction of an ocean outfall sewer which will cost between £2,000,000 and £3,000,000. This will intercept the sewage at present going to those two treatment works and take it out to the ocean. The latter, in my opinion, is the most satisfactory manner of dealing with the sewage. The activated sludge treatment is not at all in the nature of what is known as the Emscher treatment. For a large city, it is preferable to discharge the effluent into the ocean if that can be managed. I am responsible for the design and construction of the water and sewerage services of various towns throughout the State. There are a number of towns having a sewerage system, but not as many as we would wish. In Goulburn, for example, the present population served by the sewers is more than 9 000. Provision has been made for sewering to deal with a population of 31,000. That is with septic tanks and aeration treatment. The effluent is disposed of on low-lying country for cultivation purposes. The works are immediately situated on the Wollondilli River, and it is found desirable to pass the effluent over the land, which is a good principle anywhere if it can be so planned. Whether it is absolutely essential, I should say that that depended on circumstances as to the degree of purity to be obtained and the volume of water in the stream to be discharged into; that is, as regards the dilution. Where land treatment after aeration cannot be arranged for it may be necessary to substitute a second aeration. With respect to the question of the offensive nature of the septic treatment, I would not say that it would prove offensive a mile distant. All treatment works have an odour. You cannot treat sewage without giving off something. You cannot treat the sewage satisfactorily without some smell. It is a condition attached to passing the sewage through certain changes. I have before me a list of eleven towns which have been sewered and have the septic treatment installed. Bathurst is one of these. The population served when the system was put in a few years ago was estimated at 8,000, and the treatment works provided for 10,000. The design of the main sewers provided for a growth of 24,000; and the cost of the scheme was £49,000, which was at the rate of £6 a head for the then existing population of 8,000. That cost included all the reticulation. These treatment works are quite near to the town; certainly within a mile and a half of its centre. We put the main sewers in to suit the forecasted population. The treatment works could serve

for the population shortly to be in sight. These works can always be added to as the need becomes imperative. I have mentioned that I prepared a report in connexion with the sewerage of Canberra, and I have seen previous reports on the same subject, including that of Mr. Oliver. The work consists of a main tunnel sewer from the point marked "B" on the plan to Western Creek, a main 5-ft. 6-in. sewer, with smaller sewers. The total estimated cost of the system—not for the reticulation, and exclusive of the treatment works—is £314,500. That includes the whole of the main sewers recommended at the present time. The period during which the effluent is conducted through the mains is apt to make a difference in the treatment. So far as the distances in the Canberra scheme are concerned, I should say that the effluent can be treated when it arrives at the outfall satisfactorily. I am asked whether, if the works were situated a mile closer to the town, that lesser distance would be a source of greater satisfaction. That matter has been very carefully considered. However, a certain portion of the work has been done for some years, and that commits one to the completed project. The then Director of Public Works in New South Wales—Mr. Davis—favoured stopping at Yarralumla Creek. As to whether anything would be gained by saving that mile of sewerage, the point is that all the tunnelling over that mile has already been done. The work has been chiefly on that particular length. If the excavation is completed, the amount of saving would be comparatively small. The wisest course would be to finish now to Western Creek. It would be better to complete the sewer, and that would obviate the necessity of having to move the treatment works at some future date. Even if I were dealing with the scheme afresh from to-day, I would carry it out to Western Creek. As for the exact character of the work to be done, that would be entirely a matter of comparative estimates on present day prices. A satisfactory job can be done with either reinforced concrete, brick, or concrete *in situ*. With respect to construction on the brick-arch system with a concrete invert, we have found with the oviform sewers, for instance, at Vaucluse, that where the tunnel gets down to 3 ft. 6 in. by about 2 feet wide it pays to make the lining of the sewer, and introduce it into the tunnel, and pack around it. The bigger the sewer gets the more doubtful is the economy of that practice, and when we get to the big sewers we use the concrete. I would consider a 3-ft. 6-in. sewer as a small one. This is a matter which must depend on the local conditions. The time at which the work at the country town mentioned was carried out needs to be borne in mind, of course, in making any comparisons with the work at Canberra. With respect to the extensions of the system at the Federal Capital, I had in mind that they should take place from the point marked "B" to the power station, and simultaneously to the point "F." In accordance with the instructions given to the Advisory Committee, the objective was kept in mind of building up the northern, or civic, side simultaneously with the southern, or administrative, side of the Capital area. I should say that if we were to proceed solely with the southern portion at first, it would be likely to interfere with Mr. Griffin's scheme generally. What I mean is that, if expenditure is incurred and buildings erected only on the one side of the river it is manifest that development on that side is likely to continue to the detriment of the other, which is almost bound to be retarded and any work whatever postponed. I am asked whether I think it essential that the two areas should be developed at the same time with a view to following out our instructions to carry on in consonance with Mr. Griffin's scheme. If the buildings for civic purposes were erected on other localities than that laid down for them by Mr. Griffin in his project for the establishment of a civic centre, there would be a civic area growing up on the left-hand bank of the Molonglo, whereas the designer's plan provides for that portion to be established on the right or northern side. I repeat that, to bear in mind the development of Mr. Griffin's plan, the two areas should be developed hand in hand. I feel convinced that, if development were continued in regard to major works, and confined exclusively to the southern bank, Mr. Griffin's plan for a civic centre and for the development of the northern side would be imperilled.

24A. *To Mr. Mathews.*—The activated sludge system is a more modern method than the septic treatment, and it gives a very high-class effluent. There is a great degree of purification, but it produces a great deal of sludge, and is very costly. The treatment is partly biological. It specially consists in the introduction to the sewage of large volumes of air to bring oxygen into contact with the sewage in the early stages of its reaching the treatment works. The result is that the sewage is quickly treated and the effluent is of very high quality. One can continue the septic treatment until an equal degree of purity is obtained, but it takes longer. In the septic system the residue is measurably less; I do not think there would be much difference in respect to the odour, however. The changes in the sewage begin in the sewer and continue throughout the whole of the period of its travel through the sewer. It is not necessarily finished when it reaches the tanks. The treatment is completed in the tanks upon arrival. If, in the early stages of the development of the city, the flow was insufficient, flushing would have to be resorted to. That would be desirable, and could be easily brought about. The presence of water for flushing would not interfere with the biological treatment. That is to say, such quantity as would be required for flushing would not be harmful. As for the distance over which the sewage will be conducted at Canberra, and with regard to the question of the satisfactory nature of the treatment, all engineers prefer to treat the effluent fresh; but I do not consider that the time during which the sewage will be passing through the system will be a bar to proper treatment. With a population of 6,000 spread on both sides of the river, it may be necessary in periods of low flow to resort to flushing. The flow of sewage is concentrated in about six out of the twenty-four hours. At the periods of low flow some flushing may be found necessary. Bath water is a considerable item in a settlement of this kind, and the maximum flow has to be dealt with over a small number of hours. We have many sewers where we have to provide for flushing in the early stages of population. There would be no difficulty in the matter of water for flushing the sewers. We prefer steeper grades than are to be found at Canberra, but we deal with the country as we find it. In the various towns throughout New South Wales where sewerage systems have been installed provision has been made in nearly every instance for the effluent to be used for cultivation; but the local authorities rarely appear to take much advantage of it. They do not appear to be seized of the value of the effluent for cultivation purposes. I prefer the spreading of the effluent for a heavier crop than ordinary grass for grazing; one that involves cultivation. I prefer the cultivation of corn rather than the mere establishment of a sod of grass. The area at Canberra proposed to be devoted to cultivation purposes is not by any means ideal cultivation soil, and I would not put crude sewage on it, but if it is ploughed for crops and the effluent spread over it I feel sure that it would prove workable; ploughing the land before putting the effluent on is necessary in any circumstances. Although this area will flank the road leading to the Cotter, along which, no doubt, many tourists will journey in the future, I do not think that the effluvium will be anything worth troubling about. People passing may notice a slight odour, but nothing very offensive. As to whether the area could be extended further towards the hills in the event of the odour being considered obnoxious, I would not contemplate that I do not attach any importance to the subject. The gas can be burnt off the tanks, as is done at plenty of places, and that would not be expensive. In the Bathurst septic system the outfall is 1½ miles from the centre of the city, but I do not recall any complaints having to do with bad odours. We have had a complete breakdown of the treatment for a very short period at the Rookwood Asylum, due, probably, to very large quantities of antiseptics, so that liquid in the tank has solidified. But such incidents are extremely rare; I do not suggest that the whole system broke down. It becomes a mere matter of using one of the other tanks which is available, and there is no question of the system being uncertain for any such reasons. Tanks vary in their action, but there is less trouble in treating a simple domestic sewerage such as that from Canberra than is the case in large manufacturing districts where there is trade waste and the like entering the sewers. The cost of the system for Orange worked out at about £10 11s. per head of the population, and, at Albury, at £10 18s. 10d. The latter scheme cost £65,000. That was constructed on the basis of a 6,000 population, and the job was begun before the war, although it was finished after the outbreak. The Bathurst work was still older, and it is safe to say that it could not be put in hand at a price equivalent to £6 per head to-day; it would be much more likely to be £12, or even more. With respect to the question of the cost per head at Canberra, the problem there is an entirely different one. In these other towns in New South Wales one deals with an existing population, and one can estimate the growth. The places are established, one knows the area to be covered, and the people are situated all close together. The Federal Capital is a different proposition. No one can say how many people there will be to provide for at any given time, and yet one must provide for a large number, while, at the same time, the distances are great. The work at Albury would scarcely cost double if it had to be done now, but it might amount to about £15 per head. There is no sewer of the size of the Canberra works in any of the towns which I have mentioned. All these latter are pipe sewers. The prospective population to be dealt with is not so large in these places, and, at the same time, it is extremely concentrated when compared with the area of Canberra. I have not known a case comparable with the Federal Capital site in all my experience. It represents a problem by itself.

25. *To Mr. Parker Moloney.*—In my report I calculated, as the total estimated cost of the scheme to meet the requirements of a population of 125,000, that the main sewers, including expenditure to date, would involve £314,500. That total is irrespective of reticulations and treatment works. The grand total would amount to £400,000, or more, even for the early population. I have accepted the estimates prepared by the Commonwealth engineers based on their experience at the site, and I have found no reason to question them. As to whether it would have been wise to establish the outfall nearer to the city, the difficulty was that no one could tell what the position would be. If the engineers could have stated that the Federal Capital would be carrying no population whatever up to a given period, they could have made their arrangements accordingly; but it did not appear at the time when they put the work originally in hand that it would be so long before a population became established there. If it were authoritatively stated even now that up to a given period there would be only a very small number, and if one could be given a guarantee that that number would not be exceeded up to a certain year, the works could be modified; but we would





still be faced with the plan of the city and with the necessity for providing the necessary services to the various centres of activity on the basis of Mr. Griffin's scheme. Concerning the estimate of £6 per foot run, and as to whether that is the cheapest form of construction, it becomes a question between reinforced concrete lining or concrete with brick arch, and the engineers must figure that out actually on the ground. There will not be much difference, however. Either system can be made equally effective. It is purely a question of method and of cost.

26. *To Senator Plain.*—I am asked whether, if it were deemed necessary to limit expenditure on sewerage in order to push ahead with other important works at Canberra, that would materially affect Mr. Griffin's scheme. It would not affect the proposals so far as concerns the portion of the sewer system at present under consideration; but, if it were decided to discontinue development on the civic side, there would be a saving later on. I do not consider that the sewerage service is one on which expenditure could be reduced if so desired, at any rate, up to the point marked "B." I am asked whether my statement implies that the work up to the points "E" and "F" can be left alone for the time being. That is where the consideration of the curtailment of the scheme would begin to take place. The point "B," however, is common to everything. Accepting the site for the Federal Capital as it has been selected, and recognising that, in my opinion, you must take the sewage out of the city for treatment at a proper distance—and there should be no compromise in that direction—there is very little to be gained by shortening the distance or by attempting to reduce the size of the sewers, because the saving of money would not be in any way proportionate. As a matter of fact, there is a minimum size of tunnel which can be economically driven. It is prescribed in the working awards of the Courts, and there is the question of the distance of the shafts from each other. The work must be carried on to the point marked "B" if there is to be a Federal Capital city at all. Beyond that, as to the course of the remaining sewers and the localities which they are to drain, that will become a matter for the development of the accepted plan of the design of the city itself. I am asked to suppose that the land on which the effluent is to be settled may not be found suitable for irrigation purposes, and that it may become necessary to let the effluent flow as best it can to the nearest stream. We are relying to a very small extent upon any purification on the land. That will be merely an auxiliary. The effluent could be rendered fit and go into the river without going on to the land at all. As a New South Wales officer, it is my duty to safeguard the rivers of this State, and I would be watchful to see that no harm was occasioned. There need be no anticipation of that, however.

27. *To the Chairman.*—If it were not intended to largely develop the area about the power house for a considerable time, that neighbourhood could continue to carry on with the septic tank system, for a while, at any rate. As to whether, if I were carrying out the work, I would do it by day labour or by contract, I might say that we have recently found difficulty in getting satisfactory contracts. There has not been much competition, and prices have been high. At present, a large sewerage work on which I am engaged is being carried out by day labour. We invite tenders, and if they are found satisfactory and the firm is a good one, we naturally prefer to let the contract. I am speaking of the engineers, and not of Government policy just now; but, if the tenders are so high that we know that we can do the work more cheaply ourselves, we recommend that we take it in hand departmentally. That is the practice of my Department.

*(Taken at Sydney.)*

WEDNESDAY, 21st DECEMBER, 1921.

(SECTIONAL COMMITTEE.)

*Present:*

Mr. GREGORY, Chairman;

Senator Plain, Mr. Mathews; | Mr. Parker Moloney.

Herbert Ernest Ross, Architect and Consulting Engineer, Sydney, sworn and examined.

28. *To the Chairman.*—I am aware of the reference to this Committee of the matter of the Federal Capital sewerage system. I am a member of the Advisory Committee which has reported thereon to the Government. I have made myself acquainted with the report of Mr. Oliver respecting the treatment of the sewage biologically in various parts of the city. I most emphatically insist that that report of Mr. Oliver, together with his recommendation, is all wrong. I do not often speak as strongly upon any matter as I feel in this relation, but the recommendation is a most astonishing one. I have had some experience, and I have investigated the subject with Professor Chapman in connexion with the Folly Point sewerage works. Of course, the State Government will not admit it, nor will the Sewerage Board, but from the evidence which I collected I can assure this Sectional Committee that the odour and the trouble generally arising from those septic tanks are matters which become extremely detrimental to the growth of a residential neighbourhood. If you can avoid the treatment of sewage locally in a populated locality, it is very desirable to so so. Despite the enthusiasm of the biological experts, it is a fact that the septic treatment of sewage is a long way from perfect as yet. The activated sludge method has been advocated, and certain improvements have been made thereon, but it is a long way from right so far. The establishment of Emscher tanks distributed through a city such as the Federal Capital would be a fatal mistake. I am asked whether, in the early stages of a city's development, with sewerage pipes 5 ft. 6 in. by 3 ft. 8 in., traversing many miles, and serving only a small population, fair biological treatment can be expected. In the first few years the biological treatment at the outfall will be far from satisfactory, but it will be so far removed from the heart of the settlement that the unsatisfactory nature of the effluent need not be a factor in disturbing the population. You would get precisely the same results with a local tank which, necessarily, much be just as much out of proportion at some stage as the major scheme itself, the only difference being that you would get the unsatisfactory condition right under you nose in your own home, so to speak, as against having it 7 miles away. The suggestion of connecting up the system with Duntroon Military College, in order to secure a more active flow, is not material, because, in any case, it will be necessary to flush the sewers regularly during the early stage of population. Flushing will be essential for several reasons, and that must disturb the effluent at the outfall. For some years the treatment at the outfall works, until the population grows, will be unsatisfactory. I have no suggestion to offer for a more effective method of treatment. I believe that the recommendation of the Committee is in every way the best one which can be suggested; that is, taking into account the peculiar conditions of the growth of Canberra, its sparse population, and the necessity for establishing sewers really out of all proportion to the early need. No matter what other scheme might be decided upon, one is bound to have trouble in the initial period. The problem of Canberra is one entirely by itself. The estimated cost does appear to be a little high. I agree that the pre-cast method of constructing concrete sections on the works and fitting them in afterwards and reinforcing them is the proper system. It involves the establishment of a certain amount of plant, but its advantage is that you can inspect and pass the work before it goes underground. Concerning the fact that the engineers have reported that the reinforced concrete pipe method would be more expensive, I might say that there will be places where it will become necessary to make use of that scheme of construction, but in the rock I do not necessarily hold with the use of reinforced concrete. The engineers ought to be able to cut a tunnel in that class of country as cheaply as any tunnel of the same size in the Commonwealth—cheaper, indeed, than has been the case in respect of the work done in Sydney and Melbourne. There again, however, the question of labour and of its concentration in a recognised labour centre enters into consideration. If Canberra were made a centre, with a special award and rate of wage, the position would be more definite.

29. *To Mr. Mathews.*—With respect to my disagreeing with Mr. Oliver's recommendation, I do not know whether that gentleman's experience has been similar to mine. I have had considerable experience with a large number of small tanks all over the country, rather than with big city installations. The recommendation of the Advisory Committee is not for any specific treatment at this particular stage. The development of the treatment idea is coming on rapidly, and cannot be said as yet to have been really brought to fruition. In Baltimore, in the United States of America, there was a very big system of Imhoff plant, and, according to the technical reports, it was a tremendous mistake. On the other hand, the activated sludge system at Folly Point is, in my view, not satisfactory. It has improved in three years 100 per cent., but the progress of the treatment is rapid, and our advice is not to be committed to anything but to deliver to a certain point and, whatever system of treatment is adopted, we can then go ahead. The place is so distant from a populated area that if you choose to wait still longer for development you can lift the effluent and make a sewage farm without any difficulty; or you can give it a certain amount of treatment for liquefaction purposes and pump the effluent on to the land. But the whole business is so remote from the centre of population that you are in a position finally to get the most perfect ultimate development. It is true that the road to the Cotter River passes nearby, and that will carry a fair number of tourists. Whatever offence may be noticed, it can be passed by instead of having it all the time among the inhabitants in the city. The activated sludge system is the most expensive. There is the question of the removal of the residue. I have examined the ground about Western Creek, and although it is not ideal for cultivation, it is fairly porous soil, and, no doubt, the sludge could be worked into the land without offence and with profit. There is not so much residue in the septic as in the sludge system, but there would not be a great deal of difficulty in the completion of both processes.



*(Taken at Sydney.)*

THURSDAY, 22nd DECEMBER, 1921.

(SECTIONAL COMMITTEE.)

*Present:*

Mr. GREGORY, Chairman;

Senator Plain, Mr. Mathews; | Mr. Parker Moloney.

Leslie Wilkinson, Professor of Architecture, University of Sydney, sworn and examined.

30. *To the Chairman.*—I have seen the report of the Advisory Committee, and I am conversant with the accepted design of Mr. Griffin for the Federal Capital. I have not had experience on a large scale of city sewerage systems. I am aware that the biological treatment of the sewage within the city boundaries has been advocated. Whether it would be advisable to have the sewage taken to a distance and treated, or to have it biologically treated within the confines of the city, depends very largely on the volume of the sewage to be dealt with. In the future it must be got away; but as to whether it would be advisable in the early stages, in order to save expense, I should think that it could be dealt with locally. To have a system as extensive as 5 ft. 6 in., running between the points "A" and "B" on the plan, appears to me to be very large compared with the service for the city and suburbs of Sydney. I should think that there might be difficulty in getting a sewer of such a size properly flowing in view of the small amount of use to which it would be put. Something in the nature of flushing would be needed.

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